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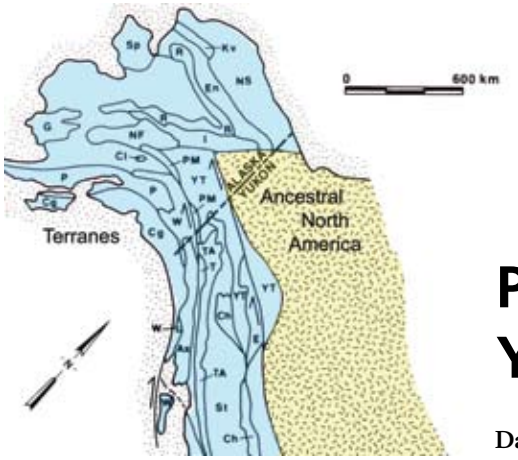


Figure 2. Generalized map of terranes of Alaska and Canada. Ancestral North America is shown in yellow, and the various accreted terranes are shown in blue. The Woodchopper Canyon terrane is too small to been seen at this scale and is part of the Yukon terrane (YT). Modified from Coney et al. (*1980*).

Figure 1. (Left) Outcrop and talus slope of Woodchopper limestone on the north side of the river opposite Woodchopper Roadhouse. The limestone is slightly recrystallized and contains abundant disarticulated crinoids and sparse brachiopods and corals.

Paleogeography of Woodchopper Volcanics, Yukon-Charley Rivers National Preserve, Alaska

David M. Rohr, Robert B. Blodgett, and Douglas Beckstead

In recent years, the concept that nearly all of Alaska, as well as much of the western Cordillera of North America, are composed of numerous discrete, accreted tectonostratigraphic terranes (*Figure 2*) has gained general acceptance. The only exception to this in Alaska is the triangular area of east-central Alaska, bounded on the northwest by the Porcupine River and on the southwest by the Yukon River.

The Yukon River meanders through the Yukon-Charley Rivers National Preserve for a distance of approximately 130 river miles in a roughly east-west transect across the Charley River 1:250,000-scale quadrangle. The river exposes a record of 800 million years of Earth history (Precambrian through Cenozoic) and contains an extensive fossil record. These rocks are separated into two disparate portions by an obliquely transecting basin of deep-water flyschoid rocks of Jura-Cretaceous age. Fossils from the eastern belt are relatively well known and are from autochthonous (non-accreted) strata belonging to the western edge of the Paleozoic North American continental margin. However, fossils and strata of the western belt of pre-Jurassic age rocks exposed along the Yukon River and the adjoining low hills to the north and south are more poorly understood.

Examination of the limited published reports as well as the more extensive unpublished fossil lists in the Alaska Paleontological Database (**www.alaskafossil.org**) show many anomalous taxa, particularly in the Devonian, Permian, and Triassic. These taxa, particularly brachiopods, are not known from cratonic North America, but have Asian affinities. The goal of the ongoing study is to resolve the question of whether or not this western belt represents an assemblage of accreted terranes, and what are their paleobiogeographic affinities and possible paleogeographic origin. Fossils have proven in the past two decades to have great utility in the study of Paleozoic biogeographic affinities and possible origins of accreted terranes along the western margin of North America (*Blodgett et al. 2002*).

This western belt has been suggested as being composed of several tectonostratigraphic terranes in previous tectonic reconstructions of this area (*Churkin et al. 1982, Jones et al. 1981, Nokleberg et al. 1994, Silberling et al. 1994*); however, the terrane units recognized show no consistency (and usually quite conflicting usage) between the various authors. Terrane names applied include: Woodchopper Canyon terrane (*Churkin et al. 1982, Jones et al. 1981, Silberling et al. 1994*), Slaven Dome terrane (*Churkin et al. 1982*), Circle terrane (*Churkin et al. 1982*), Takoma Bluff terrane (*Churkin et al. 1982*), Porcupine terrane (*Jones et al. 1981, Nokleberg et al. 1994, Silberling et al. 1994*), Tozitna terrane (*Jones et al. 1981, Silberling et al. 1994*) and Angayucham terrane (*Nokleberg et al. 1994*).

Mertie (*1930*) named the Woodchopper Volcanics for complexly folded and faulted basalt and pyroclastic rocks, interbedded limestone, shale, and chert cropping out along both banks of the Yukon River from the mouth of Coal Creek (*Figures 3 and 4*) and extending 15 miles downstream

to the south bank of the Yukon beyond the mouth of Thanksgiving Creek (*Figure 3*). Edwin Kirk identified the fossils and regarded them as Middle Devonian (*Mertie 1930, 1937*). Mertie (*1930*) noted that the formation differed from other Middle Devonian units in Alaska in that it is mainly volcanic and that the fauna appeared to be diferent from the typical Middle Devonian fauna.

Mertie (*1937*) illustrated two masses of fossiliferous limestone, the type section later designated by Lane and Ormiston (*1976*), on the north side of the Yukon above Woodchopper Creek. Mertie (*1937*) described the limestones as being recrystallized to varying degrees, and the fossils as poorly preserved.

Brabb and Churkin (*1969*) mapped the Charley River Quadrangle and placed the Woodchopper Volcanics in fault contact with the Permian Step Conglomerate and Paleozoic argillite to the north and in fault contact to the south with the Permian Tahkandit limestone and Cretaceous Biederman argillite. Dover and Miyaoka (*1988*) reinterpreted the map placing the Woodchopper in fault contact to the north with the Devonian Nations River conglomerate and McCann Hill Chert. They also mapped a syncline in the Woodchopper in the Thanksgiving Creek area.

Lane and Ormison (*1976*) determined an Early Devonian (Emsian) age for the type section of the Woodchopper Volcanics (see geologic time terms in Figure 9). Conodonts found included

Figure 3. The Woodchopper Volcanics are named for Woodchopper Roadhouse, across the Yukon River from the outcrops of the formation. Coal Creek and Woodchopper Creek were the site of gold placer mining. Squares are six miles on each side. From USGS Charley River 1:250,000 topographic map.

Photograph by David Rohr

Figure 4. View to the north across the Yukon River at Woodchopper Roadhouse. Cliffs are the Devonian-age Woodchopper Volcanics with an interbedded limestone layer at right.

Polygnathus dehiscens, P*elekysgnathus furnishi*, *Pelekysgnathus* cf. *P. serratus*, and *Pandorinellina exigua*. Megafossils included the coral *Xystriphyllum* sp. They also evaluated the megafossil identifications made in Mertie.

Brabb and Hamachi (*1977*) provided chemical analyses of seven samples of volcanic rocks from the Woodchopper.

Churkin, Trexler and Carter (*1982*) reported Early Devonian (Pragian) graptolites (*Monograptus yukonensis*) from a volcanic rock section 5.5 km downstream of the mouth of Woodchopper Creek.

Churkin et al. (*1982*) named the fault-bounded Woodchopper Canyon Terrane to include the basaltic pillow lavas, pillow breccia, submarine tuffs, volcanic graywacke, and minor shale and limestone. They also observed turbidites and olistostromes in the Woodchopper, and concluded that the shelly fauna was transported into deeper-water deposits interbedded with the volcanics.

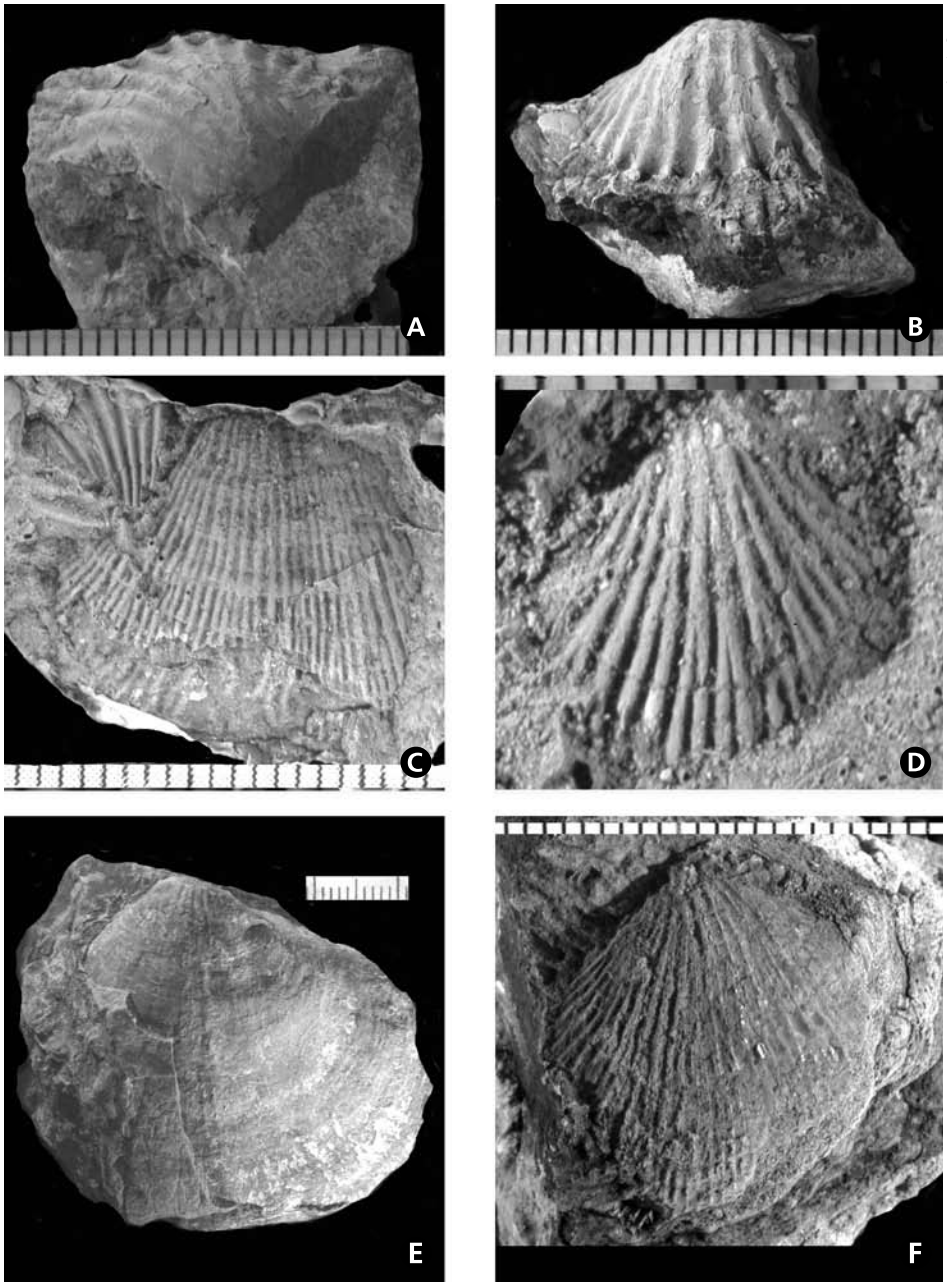
As part of the present study, field work was conducted in June 2006 by David Rohr, Robert B. Blodgett, and Doug Beckstead. Our objective was to access a number of previously known localities (from the Alaska Paleontological Database), and to gather a large, taxonomically diverse collection of Devonian fossils. During our visit, the Yukon River was high, many of the

Photograph by David Rohr

Figure 5. Pillow basalts of the Woodchopper Volcanics exposed in a cliff on the north side of the Yukon River.

Photograph by David Rohr

Figure 6. Pillow basalts in the Woodchopper Volcanics were first illustrated and described by J. B. Mertie in the 1930s as "ellipsoidal basalts". Pillow basalts are now generally accepted as evidence of subaqueous volcanic activity and formed by repeated oozing and quenching of the hot basalt.



Photograph by David Rohr

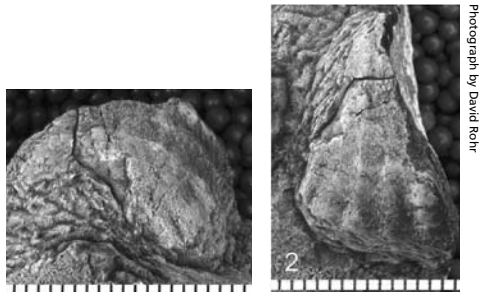
Figure 7. Devonian brachiopods from limestone bed within the Woodchopper Volcanics. (A) and (B) *Vagrania* sp., YUCH 2993; (C) *Schizophoria* sp., YUCH 2994; (D) indeterminate atrypid; (E) undetermined smooth brachiopod, YUCH 2995; (F) *Desquamatia*? sp., YUCH 2996. Scale is in millimeters.

intended collection sites were under water, and only two sites were accessible. One locality is a talus slope on the north side of the river adjacent to and below an outcrop of Woodchopper limestone (*Figure 4*). The limestone is a slightly recrystallized packstone to grainstone with abundant disarticulated crinoids and sparse brachiopods and corals. The second locality is talus below Woodchopper limestone outcrops on the south side of the river. The latter material is also recrystallized and contains slightly more abundant tabulate corals.

The limestone of the formation occurs interbedded with thick units of pillow basalts that are spectacularly exposed in cliffs along the river (*Figure 3, 5, and 6*). These volcanics were described by Mertie (*1930, 1937*) as ellipsoidal flows. Pillow basalts are now generally accepted as evidence of subaqueous volcanic activity and formed by repeated oozing and quenching of the hot basalt. The interbedded marine limestone indicates an origin on an oceanic plate or an island-arc setting.

Brachiopods from the Woodchopper are poorly preserved and include *Schizophoria* sp., *Ivdelinia* sp., indet. gypidulids, *Desquamatia*? sp., *Vagrania* sp., and indet atrypids (*Figure 7*). Solitary rugose corals belonging probably to the genus *Acanthophyllum* are relatively common.

Although most of the brachiopod elements are relatively cosmopolitan, the Eurasian aspect of the fauna is indicated by the typical Old World Realm gypidulinid *Ivdelinia* (*Figure 8*). The genus



Photograph by David Rohr

Figure 8. *Ivdelinia* sp., specimen YUCH 2997. The brachiopod genus *Ivdelinia* is widely reported from Early Devonian and early Middle Devonian age rocks of the Rhenish-Bohemian and Uralian Regions, but is almost wholly unknown in cordilleran North America. The presence of *Ivdelinia* indicates a link to Eurasia and the accreted Farewell terrane of southwest Alaska. Scale is in millimeters.

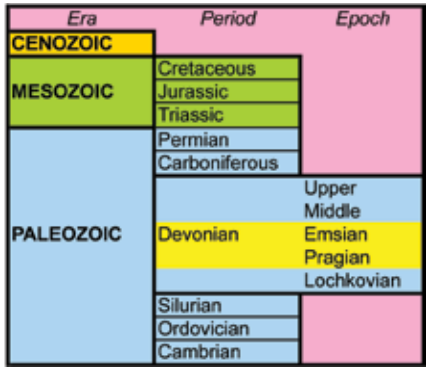
is widely reported from Early Devonian (Lochkovian-Emsian) and early Middle Devonian (Eifelian) age rocks of the Rhenish-Bohemian and Uralian Regions, but is almost unknown in the Cordilleran Region of the Old World Realm which, in the Emsian, included Arctic and western Canada and Nevada. Only two species have been described from Emsian-Eifelian strata of the Cordilleran Region: these are *Ivdelinia grinnellensis*, and *Ivdelinia* (*Ivdelinella) ellesmerensis*), both of which occur in the Canadian Arctic islands. The only other place in Alaska in which the Ivdelinia occurs is at Shellabarger Pass in rocks belonging to the Mystic subterrane of the Farewell terrane (*Blodgett et al. 2002*).

Based on our observations of the pillow basalts and limited collections from the

interbedded limestone we conclude that the Woodchopper Volcanics represent part of an accreted terrane not related to cratonic North America. It may have originated in an oceanic island-arc setting adjacent to the Urals and may be related to the Farewell and Alexander terranes of southern Alaska, which likewise have Emsian biotas of Uralian and/or Siberian aspect.

Fieldwork in Summer 2006 was supported by grant 7987-06 from the National Geographic Society to Rohr. Transportation and logistical support in the Yukon-Charley Rivers National Preserve was provided by the National Park Service. Specimen numbers are those of the Yukon-Charley Rivers National Preserve.

Figure 9. Generalized geologic times scale showing the divisions of the Devonian Period referred to in text.



REFERENCES

Blodgett, R.B. Alaska Paleontological Database. (www.alaskafossil.org).

Blodgett, R.B., D.M. Rohr, and A.J. Boucot. 2002.
Paleozoic links among some Alaskan accreted terranes and Siberia based on megafossils. In *Tectonic Evolution of the Bering Shelf-Chukchi Sea-Arctic Margin and Adjacent Landmasses*, edited by E.L. Miller, Art Grantz, and S.L. Klemperer. Geological Society of America Special Paper 360, pp. 273-291.

Brabb, E.E., and Michael Churkin, Jr. 1969.
Geologic map of the Charley River quadrangle, east-central Alaska. U.S. Geological Survey Miscellaneous Geologic Investigations Map I-573, 1 sheet, scale 1:250,000.

Brabb, E.E., and B.R. Hamachi. 1977.
Chemical composition of Precambrian, Paleozoic and Tertiary rocks from east-central Alaska. U.S. Geological Survey Open-File Report 77-631.

Churkin, Michael, Jr., H.L. Foster, R.M. Chapman, and F.R. Weber. 1982.
Terranes and suture zones in east central Alaska. Journal of Geophysical Research 87(B5): 3718-3730.

Churkin, Michael, Jr., J.H. Trexler, and Claire Carter. 1982.
Graptolites discovered in the Woodchopper Volcanics. In The United States Geological Survey in Alaska—Accomplishments in Alaska during 1980, edited by W.L. Coonrad. U.S. Geological Survey Circular 844, pp. 53-56.

Coney, P.J., D.L. Jones, and J.W.H. Monger. 1980.
Cordilleran suspect terranes. Nature 288:329-333.

Dover, J.H., and R.T. Miyaoka. 1988.
Reinterpreted geologic map and fossil data, Charley River quadrangle, east-central Alaska. U.S. Geological Survey Miscellaneous Field Studies Map MF-2004, 2 sheets, scale 1:250,000.

Jones, D.L., N.J. Silberling, H.C. Berg, and George Plafker. 1981.
Preliminary terrane map of Alaska. U.S. Geological Survey Open-file Report 81-792.

Lane, H.R., and A.R. Ormiston. 1976.
The age of the Woodchopper Limestone (Lower Devonian), Alaska. Geologica et Palaeontologica 10:101-108.

Mertie, J.B., Jr. 1930.
Geology of the Eagle-Circle district, Alaska. U.S. Geological Survey Bulletin 816.

Mertie, J.B. 1937.
The Yukon-Tanana region, Alaska. U.S. Geological Survey Bulletin 872.

Nokleberg, W.J., E.J. Moll-Stalcup, T.P. Miller, D.A. Brew, A. Grantz, J.C. Reed Jr., G. Plafker, T.E. Moore, S.R. Silva, W.W. Patton, Jr., with contributions on specific regions by R.B. Blodgett, S.E. Box, D.C. Bradley, T.K. Bundtzen, C. Dusel-Bacon, B.M. Gamble, D.G. Howell, H.L. Foster, S.M. Karl, M.L. Miller, and S.W. Nelson. 1994.
Tectonostratigraphic terrane and overlap assemblage map of Alaska. U.S. Geological Survey Open-File Report 94-194, 1 sheet, scale 1:2,500,000.

Silberling, N.J., D.L. Jones, J.W.H. Monger, P.J. Coney, H.C. Berg, and G. Plafker. 1994.
Lithotectonic terrane map of Alaska and adjacent parts of Canada. In *The geology of Alaska*, edited by G. Plafker and H.C. Berg. Geological Society of America. Boulder, Colorado.